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Characterisation of the structural heterogeneity of the soil tilled layer in the field by 3D electrical resistivity measurements

I. Cousin (1), M. Seger (1,2), G. Giot (1); F. Mahu (3), H. Boizard (3), G. Richard (1)

(1) INRA, UR0272 Science du sol, Centre de recherche d'Orléans, BP 20619, F-45166 Olivet cedex, France, (2) Cemagref - UR TSCF - Equipe CAPSOL, 24 avenue des Landais, BP 50085, F-63172 Aubière cedex, France, (3) INRA, UR1158 Unité d'Agronomie Laon-Reims-Mons, 2 Chaussée Brunehaut, Estrées-Mons, BP 50136, F- 80203 Péronne, France (Isabelle.Cousin@orleans.inra.fr)

Agroenvironmental models usually describe the water transfer in soils. Their accuracy depends on our ability to propose correct soil hydrodynamic properties and to describe properly the 3D soil structure. The latter evolves rapidly in the field under the effects of climate, biology, and anthropic actions like traffic and tillage. We then need non-destructive tools that enable the description of the 3D soil structure in the field at a centimetric or decimetric resolution. Former works have demonstrated the feasibility of the electrical resistivity to see cracks in the cultivated layer and to identify 2D zones that have been compacted by the traffic. The aim of this work is to discuss the feasability of the electrical resistivity to describe a complex 3D structure in the field. The studied zone - a 2.4 m x 2.4 m field plot - consists in a compacted band, first created by a heavy tractor, that has then been fragmented by ploughing. The structure is composed by dense aggregates, loose material and large voids. The electrical structure of the studied zone has been characterised thanks to Wenner arrays of 24 electrodes separated 10 cm apart, the arrays being parallel or perpendicular to the main compaction axis. Several 3D arrays of 48 electrodes have been added to the database. The analysis of apparent resistivity data has shown that we can localise zones with large voids, and zones with compacted aggregates. The inversion of the apparent resistivity data by the Res3DInv software has evidenced the position and ori-

entation of the compacted aggregates. This has been confirmed by direct observations on soil profiles. Our method then enables the description of the 3D heterogeneity of the tilled layer at a decimetric resolution and constitutes then an alternative tool to the X-ray tomography for studies in the field and at larger scales.